

AMENDMENTS TO THE CLAIMS

1. (Currently Amended) A method of manufacturing a tubular carbon molecule, the method comprising:

a catalyst arranging step of arranging a metal having a catalyst function for a tubular carbon molecule through use of melting by a modulated heat distribution; [[and]]

a growing step of growing a tubular carbon molecule;

a height equalizing step of forming a tip of the tubular carbon molecule in a predetermined plane, and forming the tip into an open tip; and

an inserting step of inserting a magnetic material in at least tip portions of a plurality of tubular carbon molecules from open tips of a plurality of tubular carbon molecules.

2. (Previously presented) A method of manufacturing a tubular carbon molecule according to claim 1, wherein:

heat distribution is applied through diffracting an energy beam in a one-dimensional direction or a two-dimensional direction.

3. (Canceled)

4. (Currently Amended) A method of manufacturing a tubular carbon molecule according to claim [[3]], wherein:

in the height equalizing step, after a fixing layer is formed at least around the tubular carbon molecule to fix the tubular carbon molecule, polishing on the tubular carbon molecule together with the fixing layer is carried out.

5. (Previously presented) A method of manufacturing a tubular carbon molecule according

to claim 4, wherein:

the polishing is carried out by chemical mechanical polishing.

6-9. (Canceled)

10. (Currently Amended) A method of manufacturing a tubular carbon molecule according to claim [[9]]1, wherein:

in the height equalizing step, after a fixing layer is formed at least around the tubular carbon molecules to fix the tubular carbon molecules, polishing on the tubular carbon molecules together with the fixing layer is carried out, and

in the inserting step, after a thin film made of the magnetic material is formed on the fixing layer so as to block the open tips, polishing on the thin film is carried out.

11. (Currently Amended) A method of manufacturing a tubular carbon molecule according to claim [[10]]1, wherein:

the polishing is carried out by chemical mechanical polishing.

12. (Canceled)

13. (Currently amended) A method of manufacturing a tubular carbon molecule according to claim [[12]]50, wherein:

the second material is a material which lowers a melting point of the first material by adding the second material to the first material.

14. (Currently amended) A method of manufacturing a tubular carbon molecule according

to claim [[12]]50, wherein:

in the depositing step, the second material is deposited on the surface of the material substrate in a planar shape through dissipating heat of the surface of the material substrate.

15. (Canceled)

16. (Currently amended) A method of manufacturing a tubular carbon molecule according to claim [[12]]50, wherein:

the first material is a semiconductor or a metal, and the second material is a metal having a catalyst function.

17. (Canceled)

18. (Currently Amended) A method of manufacturing a tubular carbon molecule according to claim [[17]]51, wherein:

in the transferring step, a relative position between the master for transfer and the substrate to be transferred is shifted to transfer the pattern of the master for transfer to the substrate to be transferred a plurality of times.

19. (Currently Amended) A method of manufacturing a tubular carbon molecule according to claim [[17]]51, wherein:

a heating process is carried out in the transferring step.

20. (Canceled)

21. (Canceled)

22. (Currently amended) A method of manufacturing a tubular carbon molecule according to claim [[21]]53, further comprising:

a top surface transferring step of transferring the planarized top surface of the projection to a substrate to be transferred.

23. (Canceled)

24. (Canceled)

25. (Previously presented) A method of manufacturing a recording apparatus, the method comprising:

a catalyst arranging step of arranging a metal having a catalyst function for a tubular carbon molecule through use of melting by a modulated heat distribution;

a growing step of growing a tubular carbon molecule;

a height equalizing step of forming a tip of the tubular carbon molecule in a predetermined plane, and forming the tip into an open tip; and

an inserting step of inserting a magnetic material in at least a tip portion of the tubular carbon molecule from the open tip.

26. (Previously presented) A method of manufacturing a recording apparatus according to claim 25, wherein:

in the height equalizing step, a fixing layer is formed at least around the tubular carbon molecule to fix the tubular carbon molecule, and polishing on the tubular carbon molecule together

with the fixing layer is carried out, and

in the inserting step, a thin film made of the magnetic material is formed on the fixing layer so as to block the open tip, and polishing on the thin film is carried out.

27. (Previously presented) A method of manufacturing a recording apparatus according to claim 26, wherein:

the polishing is carried out by chemical mechanical polishing.

28. (Currently Amended) A method of manufacturing a field electron emission device, the method comprising:

a catalyst arranging step of arranging a metal having a catalyst function for a tubular carbon molecule on a substrate through use of a modulated heat distribution the substrate having a pattern of a projection in which at least a tip portion thereof is made of the metal; and

a cathode forming step of forming a cathode through growing a tubular carbon molecule, wherein two substrates are disposed so that the patterns of the projection face each other, and an electric field is applied between the two substrates.

29. (Canceled)

30. (Previously presented) A method of manufacturing a field electron emission device according to claim 28, wherein:

the substrate has a planar pattern made of the metal.

31. (Canceled)

32. (Canceled)

33. (Canceled)

34. (Previously presented) A method of manufacturing a field electron emission device according to claim 28, wherein:

the metal is arranged with a spacing of 100 nm or less.

35. (Previously presented) A method of manufacturing a field electron emission device according to claim 28, wherein:

the metal is arranged with a spacing of 50 nm or less.

36. (Canceled)

37. (Original) A method of manufacturing a field electron emission device according to claim 28, further comprising:

a separation groove forming step of forming a separation groove on a surface of the substrate so as to avoid the metal.

38. (Previously presented) A method of manufacturing a field electron emission device according to claim 37, wherein:

the separation groove is formed by irradiation with an energy beam.

39. (Previously presented) A method of manufacturing a field electron emission device according to claim 37, wherein:

the separation groove is formed through diffracting an energy beam in a one-dimensional direction or a two-dimensional direction.

40. (Previously presented) A method of manufacturing a field electron emission device according to claim 37, wherein:

the separation groove is formed in a parallel line or a grid.

41. (Original) A method of manufacturing a field emission device according to claim 28 further comprising:

an extraction electrode forming step of forming an extraction electrode corresponding to the cathode.

42. (Previously presented) A method of manufacturing a field electron emission device according to claim 41, wherein:

the extraction electrode forming step is carried out between the catalyst arranging step and the cathode forming step.

43. (Previously presented) A method of manufacturing a field electron emission device according to claim 41, wherein:

the extraction electrode forming step includes:

an insulating film forming step of forming an insulating film on the substrate;

a conductive film forming step of forming a conductive film on the insulating film; and

an aperture portion forming step of forming an aperture portion in the insulating film and the conductive film corresponding to the cathode.

44. (Original) A method of manufacturing a filed electron emission device according to claim 28 further comprising:

a height equalizing step of forming a tip of the tubular carbon molecule in a predetermined plane, and forming the tip into an open tip.

45. (Previously presented) A method of manufacturing a field electron emission device according to claim 44, wherein:

in the height equalizing step, after a fixing layer is formed at least around the tubular carbon molecule to fix the tubular carbon molecule, polishing on the tubular carbon molecule together with the fixing layer is carried out.

46. (Previously presented) A method of manufacturing a field electron emission device according to claim 45, wherein:

the polishing is carried out by chemical mechanical polishing.

47. (Canceled)

48. (Canceled)

49. (Canceled)

50. (New) A method of manufacturing a tubular carbon molecule, the method comprising:
a catalyst arranging step of arranging a metal having a catalyst function for a tubular carbon molecule through use of melting by a modulated heat distribution;
a growing step of growing a tubular carbon molecule; and

wherein the catalyst arranging step includes:

a melting step of applying a modulated heat distribution to a surface of a material substrate including a second material as an additive in a first material so as to melt the surface of the material substrate;

a depositing step of depositing the second material in a position corresponding to the heat distribution through dissipating the heat of the surface of the material substrate, and in the depositing step, a projection is formed on the surface of the material substrate through dissipating heat of the surface of the material substrate, and the second material is deposited on at least a tip portion of the projection.

51. (New) A method of manufacturing a tubular carbon molecule, the method comprising:
a catalyst arranging step of arranging a metal having a catalyst function for a tubular carbon molecule through use of melting by a modulated heat distribution;
a growing step of growing a tubular carbon molecule; and
wherein the catalyst arranging step includes:

a melting step of applying a heat distribution modulated according to a desired pattern to a surface of a material substrate so as to melt the surface of the material substrate;

a master forming step of forming a projection in which at least a tip portion thereof is made of a transfer material in a position corresponding to the heat distribution on the material substrate through dissipating heat of the surface of the material substrate so as to form a master for transfer having a pattern of the projection on a surface thereof; and

a transferring step of forming a substrate through transferring the pattern of the master for transfer to a substrate to be transferred, and
the tubular carbon molecule is grown on the substrate.

52. (New) A method of manufacturing a tubular carbon molecule, the method comprising:
a catalyst arranging step of arranging a metal having a catalyst function for a tubular carbon molecule through use of melting by a modulated heat distribution;
a growing step of growing a tubular carbon molecule; and
wherein the catalyst arranging step includes:

a melting step of applying a heat distribution modulated according to a desired pattern to a surface of a material substrate so as to melt the surface of the material substrate;
a projection forming step of forming a projection of a pattern in a position corresponding to the heat distribution through dissipating heat of the surface of the material substrate; and

an adhering step of adhering a catalyst metal to a tip portion of the projection through pushing a metal substrate made of a metal having a catalyst function for a tubular carbon molecule to the projection.

53. (New) A method of manufacturing a tubular carbon molecule, the method comprising:
a catalyst arranging step of arranging a metal having a catalyst function for a tubular carbon molecule through use of melting by a modulated heat distribution;
a growing step of growing a tubular carbon molecule; and
wherein the catalyst arranging step includes:

a melting step of applying a heat distribution modulated according to a desired pattern to a surface of a material substrate so as to melt the surface of the material substrate;
a projection forming step of forming the pattern of a projection in a position corresponding to the heat distribution through dissipating heat of the surface of the material substrate; and

a planarizing step of planarizing a top surface of the projection.

54. (New) A method of manufacturing a tubular carbon molecule, the method comprising:
a catalyst arranging step of arranging a metal having a catalyst function for a tubular carbon molecule through use of melting by a modulated heat distribution;
a growing step of growing a tubular carbon molecule; and
wherein the catalyst arranging step includes:
a melting step of applying a heat distribution modulated according to a desired pattern to a surface of a material substrate so as to melt the surface of the material substrate;
a projection forming step of forming the pattern of a projection in a position corresponding to the heat distribution through dissipating heat of the surface of the material substrate; and
a control layer forming step of forming a control layer which retards growth of a tubular carbon molecule on a surface of the projection except for an extreme tip portion.

55. (New) A method of manufacturing a field electron emission device, the method comprising:
a catalyst arranging step of arranging a metal having a catalyst function for a tubular carbon molecule on a substrate through use of a modulated heat distribution;
a cathode forming step of forming a cathode through growing a tubular carbon molecule, wherein the substrate and an electrode face each other, and an electric field is applied between the substrate and the electrode; and
wherein as the electrode, an electrode on which a pattern of a projection corresponding to the pattern of the substrate is formed is used, and the pattern of the substrate and the pattern of the projection of the electrode face each other.

56. (New) A method of manufacturing a field electron emission device, the method comprising:

a catalyst arranging step of arranging a metal having a catalyst function for a tubular carbon molecule on a substrate through use of a modulated heat distribution;

a cathode forming step of forming a cathode through growing a tubular carbon molecule;
and

wherein the catalyst arranging step includes:

a projection electrode forming step of forming a pattern of a projection on a surface of a flat electrode through the use of a heat distribution modulated according to a desired pattern so as to form a projection electrode; and

a reducing/depositing step of forming a pattern which is made of a metal having a catalyst function and corresponds to the projection electrode on the substrate through applying an electric field between the projection electrode and a conductive substrate in a catalyst solution including a metal having a catalyst function to reduce and deposit the metal.